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at infinity, the third vertex is the focus of the parabola into which the given conic becomes by projection.

The projection of the second triangle is a circumscribed triangle to the parabola, the circle circumscribing which triangle passing through the focus of the parabola, and proving the theorem.

The reciprocal theorem is: Two triangles are inscribed in a conic; their six sides touch another conic.

150. Proposed by WILLIAM HOOVER, A.M., Ph.D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

Find the equation to a sphere cutting orthogonally four given spheres.

Solution by the PROPOSER.

Let  $x^2 + y^2 + z^2 + 2Ax + By + Cz + D = 0 \dots (1)$ , be the sphere cutting orthogonally the spheres

$$x^2 + y^2 + z^2 + 2a_1x + 2b_1y + 2c_1z + d_1 = 0 \dots (2),$$

$$\Sigma x^2 + \Sigma 2a_1x + d_1 = 0 \dots (3),$$

$$\Sigma x^2 + \Sigma 2a_2x + d_2 = 0 \dots (4),$$

$$\Sigma x^2 + \Sigma 2a_3x + d_3 = 0 \dots (5),$$

Now, two spheres cut each other orthogonally if their radii and the distance between their centers form a right triangle; this requires, for (1) and (2),

$$(A - a_1)^2 + (B - b_1)^2 + (C - c_1)^2 = A^2 + B^2 + C^2 - D + a_1^2 + b_1^2 + c_1^2 - d_1,$$

$$\text{or, } 2Aa_1 + 2Bb_1 + 2Cc_1 - D - d_1 = 0 \dots (6).$$

Similarly for the intersection of (1) and each of (3), (4) and (5),

$$2Aa_2 + 2Bb_2 + 2Cc_2 - D - d_2 = 0 \dots (7),$$

$$2Aa_3 + 2Bb_3 + 2Cc_3 - D - d_3 = 0 \dots (8),$$

$$2Aa_4 + 2Bb_4 + 2Cc_4 - D - d_4 = 0 \dots (9),$$

(6), (7), (8), and (9) give

$$\Delta A = \begin{vmatrix} 2b_1, & 2c_1, & -1, & d_1 \\ 2b_2, & 2c_2, & -1, & d_2 \\ 2b_3, & 2c_3, & -1, & d_3 \\ 2b_4, & 2c_4, & -1, & d_4 \end{vmatrix} \dots (10),$$

and like values for  $B$ ,  $C$ , and  $D$ , which in (1) gives the required equation.

Similar demonstrations were received from J. W. YOUNG, G. B. M. ZERR, and LON C. WALKER.